MICROWAVE EXTRACTION AND MICROENCAPSULATION OF POLYPHENOL FROM *PHYLLANTHUS NIRURI*

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MASTER OF SCIENCE

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science in Chemical Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Dukung anak, mengandungi pelbagai komponen bioaktif yang menyumbang dalam bidang perubatan. Ia mempunyai sifat antioksidan, anti radang, anti kancer dan dapat mngubati Hepatitis B dan jangkitan usus penyakit kuning. Pengekstrakan ialah kaedah yang biasa digunakan untuk mendapatkan komponen bioaktif daripada bahan-bahan tumbuhan. Hasil komponen bioaktif itu bergantung kepada kaedah pengekstrakan, pelarut dan keadaan pengekstrakan. Dalam karya ini, kaedah pengekstrakan ultrasonik dan kaedah pengekstrakan gelombong mikro dikaji kerana kekurangan penyelidikan sebelum ini mengenai pengekstrakan ultrasonik dan pengekstrakan gelombang mikro telah disediakan dalam kesusasteraan. Dalam pendapatan kajian ini, didapati bahawa hasil komponen bioaktif adalah sangat bergantung kepada kekutuban pelarut yang digunakan dalam pengekstrakan, hasil tertinggi phyllanthin (4.56mg Phy/g DW) telah diperolehi dengan menggunakan 20% akueus Isopropanol manakala hasil tertinggi quercetin (10.14mg Que / g DW) telah diperolehi dengan menggunakan 20% etanol berair dan hasil tertinggi asid Gallic (15.44mg GAE / g DW) telah diperolehi dengan menggunakan air. Kekutuban pelarut meningkatkan pengeluaran kedua-dua komponen hydroxylated dan methoxylated dari *P. niruri*. Daripada analisis reka bentuk komposit pusat, pengekstrakan gelombong mikro pada kuasa pengeluaran di 250W, masa pengekstrakan dalam 2.47 minit hingga 5.72 minit dan kepekatan etanol daripada 36.58% hingga 76.31% mampu untuk mendapatkan hasil optimum pengekstrakan polifenol dengan kebaikan 91.70%. Pengekstrakan gelombong mikro disediakan pengekstrakan yang cepat tanpa ketara menjejaskan hasil pengekstrakan. produk tepung sering dikehendaki kerana jangka hayat yang lebih panjang, mudah untuk penggunaan dan mudah pengangkutan / pengendalian. Proses membuat serbuk sering dijalankan di dalam pengering semburan pada suhu tinggi (180° C). Untuk mengurangkan degradasi komponen bioaktif semasa pengeringan semburan, kaedah pemikrokapsulan diperkenalkan. WPI dan MD serbuk semburan encapsulation telah mengadakan pengekalan polifenol yang baik dari *P. niruri*. Pemikrokapsulan menggunakan campuran WPI dan MD pada nisbah 1: 9 menyumbang pengekalan tertinggi phyllanthin (84,33%), asid Gallic (88,93%) dan quercetin (88.39%) diikuti oleh MD dan WPI pengkapsulan. Pemikrokapsulan menggunakan campuran WPI dan MD pada nisbah 1: 9 dicadangkan kerana ia menyediakan pemeliharaan yang lebih baik daripada polifenol semasa pengeringan semburan yang bertentangan dengan merangkumi protein tunggal WPI dan MD. Keputusan analisis oleh UPLC menggambarkan asid Gallic dan quercetin adalah lebih mudah terdedah kepada pencemaran haba daripada phyllanthin semasa pengeringan semburan. Kajian yang lebih mendalam terhadap ujian toxic dicadangkan dengan mengunakan binatang untuk memastikan *P. niruri* extrak tidak membahayakan dalam ACCU lab yang diiktirafkan.

ABSTRACT

Phyllanthus Niruri (ver. name: Dukung Anak) contains miscellaneous bioactive compounds which contribute in various medical effects such as antioxidant, anti-inflammatory, anti-cancer and treating Hepatitis-B, jaundice intestinal infection. Extraction is the most common method to obtain the bioactive component from the plant materials. The yield of bioactive component in the extract is dependent on the solvent used, extraction method and condition. In this work, ultrasonic assisted extraction and microwave assisted extraction method were studied as there's limited work on ultrasonic assisted extraction and microwave assisted extraction were available in the literature. From the finding of this work, it is found that the yield of the bioactive component is highly dependent on solvent polarity used in the extraction, the highest yield of phyllanthin (4.56mg Phy/g DW) was obtained using 20% aqueous Isopropanol whereas the highest yield of quercetin (10.14mg Que/g DW) was obtained by using 20% aqueous ethanol and highest yield of gallic acid (15.44mg GAE/g DW) was obtained by using water. The polarity of solvent enhances the extraction of both hydroxylated and methoxylated compounds from the *P. niruri*. From the central composite design analysis, microwave assisted extraction at extraction power at 250W, extraction time ranged from 2.47 minutes to 5.72 minutes and ethanol concentration will ranged from 36.58% to 76.31% able to obtain the optimum yield of polyphenol extraction with the desirability of 91.70%. Microwave assisted extraction provided a fast extraction without significantly compromising the extraction yield. Powdered product is often desired due to its longer lifespan, convenient for consumption and easier transportation/ handling. The process of powder making is often carried out in a spray dryer at high temperature (180°C). To minimize degradation of the bioactive compounds during spray drying, microencapsulation method was introduced. WPI and MD encapsulation spray powder had performed a good polyphenol retention from *P. niruri*. Microencapsulation using mixture of WPI and MD at the ratio 1:9 delivered highest retention of phyllanthin (84.33%), gallic acid (88.93%) and quercetin (88.39%) followed by MD and WPI encapsulation. Microencapsulation using mixture of WPI and MD at ratio 1:9 is suggested as it provides a better preservation of polyphenol during spray drying as opposed to single protein encapsulate of WPI and MD. The results analysis by UPLC illustrates gallic acid and quercetin are more susceptible to thermal degradation than phyllanthin during spray drying. It is recommended to perform a toxicity analysis of *P. niruri* extract in ACCU accredited lab before it can undergo clinical trial.

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LIST OF SYMBOLS

%	Percentage
°C	Degree Celsius
hr	Hour
λ	Wavelength
ε'	Dielectric constant
kHz	KiloHertz
wt	Weight
tanδ	Dissipator factor
cm	Centimeter
mm	Milimeter
μm	Micrometer
kg	Kilogram
g	gram
ml	Mililiter

LIST OF ABBREVIATIONS

AA	Antioxidant activity
ANOVA	Analysis if variance
BHA	Butylated hydroxyanisole
CCD	Central composite design
DE	Dextrose equivalent
DoE	Design of experiment
DPPH	2,2-diphenyl-1-picrylhydrazyl
DW	Dry weight
EtOH	Ethanol
Eup	Eupatorin
FESEM	Field emission scanning electron microscopy
GA	Gallic acid
H20	Water
HPLC	High performances liquid chromatography
i.d.	Internal diameter
MAE	Microwave assisted extraction
MD	Maltodextrin

Min	Minute
PHY	Phyllanthin
QUE	Quercetin
RSM	Response surface methodology
Sec	Second
TFC	Total flavonoid content
TPC	Total phenolic content
UAE	Ultrasonic assisted extraction
UPLC	Ultra performances liquid chromatography
WPI	Whey protein isolate

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